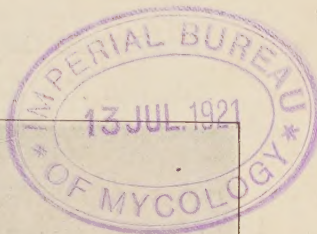


Index Each

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NEW JERSEY
AGRICULTURAL EXPERIMENT STATIONS

CIRCULAR 102



Corn Smut

DISEASES OF GRAINS AND
FORAGE CROPS

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NEW BRUNSWICK, N. J.

NEW JERSEY

AGRICULTURAL EXPERIMENT STATIONS

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DISEASES OF GRAINS AND FORAGE CROPS*

Although New Jersey is not one of the big grain-producing states, the grain crops are of very great importance. A general estimate gives us the following figures:

Crop	Acres	Bushels	Value
Corn.....	297,000	12,771,000	\$20,711,000
Wheat.....	89,000	1,691,000	3,602,000
Rye.....	69,000	1,276,000	2,233,000
Oats.....	73,000	2,482,000	1,737,000
Total.....	528,000	16,220,000	\$28,283,000

The shortage of labor and other factors resulting from war conditions will no doubt result in an increased acreage of these crops. The demand for food and the increased burden which will undoubtedly be placed on this country to supply the world with bread makes it necessary that we increase the yield to as near the maximum as possible.

It is well known that these crops are greatly reduced by fungous and bacterial diseases. Our attention has been called to wheat fields which were ruined by bunt and to corn fields in which the yield was reduced about 75 per cent by diseases. The New Jersey losses due to these grain and forage crop diseases are from 3 to 5 per cent of the yield, or from approximately three quarter million to one and one half million dollars per year. A considerable part of these losses may be prevented by practicing the well known treatments for certain of these diseases.

This circular gives brief descriptions of the most important of these diseases and the latest methods for their control.

The smuts are among the most injurious diseases of our grains, and are the causes of heavy losses in New Jersey and throughout the country. The most important of the grain smuts are the loose smut of oats, the loose smut of wheat, the stinking smut or bunt of

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wheat and the smut of corn. These diseases are all due to fungi which are very similar in general appearance and behavior, but which have different life histories and, therefore, require different treatments to insure their control.

Loose Smut of Oats

(*Ustilago avenæ* (Pers.) Jens.) (Fig 1)

This very common and well known disease occurs on the growing oats at the time of heading, causing the destruction of the grains and more or less of the chaff and the formation of a black, powdery mass. This black powder is composed of the spores of the fungus by which it is carried from year to year. It is carried by



Fig. 1. Loose Smut of Oats

the wind and more or less of it catches on the grains of the healthy plants. The loss due to this disease is very large, frequently amounting to 10 per cent or more of the crop. The loss for the entire United States has been estimated at \$20,000,000 per year. The New Jersey loss is not less than \$100,000 per year.

TREATMENT. The fact that the spores of the fungus are carried on the outside of the healthy grains makes it possible to use a treatment which will kill the spores without injuring the grains. The most convenient treatment is with formalin (or formaldehyde)

which can be purchased from the druggist at 75 to 90 cents per pound, or in large quantities much cheaper. One pound in 50 gallons of water will be sufficient for 50 bushels of grain. Spread the grain on a clean floor and sprinkle or spray thoroughly with the solution. Shovel the grain into a pile and cover with canvas or burlap for from 6 to 12 hours and then spread out to dry. The drying process may be hastened by mixing with air-slaked lime, which may be removed by the fanning mill. There are other treatments, but none more satisfactory, convenient or economical than the formalin. The fumes of the formalin are irritating to the nose and eyes, but not injurious.

A modification of this treatment, as worked out by R. J. Haskell, has proved very efficient and requires less labor. Add 1 pint of water to 1 pint of formaldehyde; pour in a small quart sprayer or atomizer and apply to 40 or 50 bushels of oats as the grain is slowly shoveled from one pile to another, taking care to spray each shovelful. One stroke of the piston is usually sufficient for one shovelful of the grain. Cover with canvas, sacks or other covering for 5 hours and sow immediately without drying. Seed treated in this manner can be kept for several weeks without material injury.

Covered Smut of Oats

(*Ustilago levis* (K. & S.) Magn.)

This disease causes a much more complete destruction of the grain than the preceding, and the spore masses are less dusty. The disease is of relatively little importance in New Jersey. The treatment is the same as for loose smut of the oats.

Loose Smut of Wheat

(*Ustilago tritici* (Pers.) Jens.)

This disease of the wheat is very similar in general appearance to that of the oats, but its life history is somewhat different. It spreads from diseased to healthy plants at time of flowering and penetrates the young grains.

TREATMENT. The fact that it is carried within the grain instead of on the outside, and that it is impossible to distinguish the healthy from the diseased grains, makes the formalin treatment unsatisfactory. By far the most satisfactory and economical method of preventing the disease is to secure seed from uninfected fields, but when it is desirable to maintain a particular strain of seed, a modification of the Jensen hot water treatment can be used. This method as devised by Freeman and Johnson is as follows: Clean the seed thoroughly and soak for 5 to 7 hours in water at 63° to 72° Fahrenheit. Put the grain in loose bags or wire baskets holding about one-half peck each for further treatment. Use two galvanized iron tubs, holding from 20 to 40 gallons, filled with water. Tub No. 1 should be kept at a temperature ranging from 110° to 120° Fahrenheit, and tub No. 2 at about 126° to 129° Fahrenheit. Plunge each bag or basket into Tub No. 1 for one minute and then

into tub No. 2 for ten minutes, keeping the grain well stirred during the entire time. Two men can treat about one bushel of grain per hour. The seed can be dried on a barn floor, but if the weather is cool it should be protected from frost.

The slowness of the hot water treatment makes it impracticable to treat any considerable amount of grain. However, the grower will find it practicable to treat a small amount of seed which can be sown in a separate field and the crop used for seed a second year. Such a field should be at a considerable distance from wheat known to be infected, or should be separated by a woodland or other wind-break to prevent infection by means of spores carried by the wind.

Stinking Smut or Bunt of Wheat

(*Tilletia fatans* (B. & C.) Trel.)

(*Tilletia tritici* (Beij.) (Wint.)

This disease is quite different in appearance from the loose smut. It fruits in the grain only, and therefore is frequently not noticed until threshing time. The diseased grains are frequently shriveled, greenish in color, and when broken are found to be filled with a mass of black spores which have a peculiar, disagreeable odor. The fungus not only destroys the grain of the diseased plants, but the diseased grains are mixed with the healthy thus making the entire crop worthless for milling and frequently for stock feed.

TREATMENT. The spores of the fungus are carried on the outside of the grain and attack the young plants. This makes it possible to treat the seed with formaldehyde in exactly the same manner as recommended for the treatment of oats for loose smut. Crop rotation and the use of clean seed are advantageous and should be practiced.

Stem Smut of Rye

(*Urocystis occulta* (Wal.) Rab.)

This disease occurs in New Jersey but the reports do not indicate that it is of much importance. It appears on the leaves and stems as long, narrow, dark grayish stripes which rupture and liberate dark dusty masses of spores. Many plants are dwarfed while those that approach full size tend to break and fall. It is very probable that the losses in New Jersey are greater than the reports indicate.

TREATMENT. Practice crop rotation, the use of clean seed and formaldehyde treatment of seed.

Leaf Smut of Timothy

(*Ustilago striiformis* (West) Miessel.)

This is a disease of timothy and a large number of other grasses. It is widely distributed throughout the country and has been reported as very destructive in several states. The disease has been found on the red top in New Jersey but thus far has not proved of any importance. The disease appears first on the leaves

and later on the stems as long, narrow lines which finally rupture and set free a black, dusty mass of spores. Severely diseased plants are dwarfed and frequently killed.

TREATMENT. Use clean seed if possible. Experimental evidence up to this date indicates that the disease can be controlled with very little injury to seed by soaking seed for six hours in cold water, then for 15 minutes in hot water at 129°-132° F. and then drying thoroughly before sowing.

Loose Smut of Barley

(*Ustilago nuda* (Jens.) Kell. & Sw.)

This very common disease sometimes causes a loss of 10 per cent of the crop. It is of very little importance in New Jersey. Usually the entire head and sometimes the upper leaves are smutted. The heads are first covered with whitish or grayish membranes which break and release the powdery masses of brownish or blackish spores. It bears a very striking resemblance to the "loose smut" of wheat.

The treatment is the same as for the "loose smut" of wheat.

Covered Smut of Barley

(*Ustilago hordei* (Pers.) K. & W.)

This disease is comparatively rare in New Jersey. The spores are formed within the grains which except the outside covering, are destroyed by the fungus. The treatment is the same as for oat smut.

Corn Smut

(*Ustilago Zeæ* (Beckm.) Ung.) (See cover).

This very common disease is well known by the black masses of spores on the ears, tassels and frequently on stalks and leaves. It occasionally causes heavy losses in field corn and is frequently very destructive on sweet corn. It has been found to be very severe in two localities in this State. The spores of the fungus are carried from season to season in the old stalks, in the manure from live stock fed on the diseased plants, and possibly on the grain.

TREATMENT. Do not use manure from animals fed on diseased plants on corn land. Burn the refuse from fields where the disease is prevalent. Practice crop rotation.

Seed Injury from Treatment

There is always danger of some injury as a result of seed treatment, especially with the wet treatments. This can be reduced by rapid, thorough drying. Furthermore, it must be remembered that the wet treatments cause a swelling, and therefore a measure of treated grains contains a smaller number of seeds than a corresponding measure of untreated grains. When sowing grain treated by wet method the amount should be increased about 20 per cent.

Corn Wilt

(*Pseudomonas stewartii* E. F. Smith)

This is a bacterial disease which may cause the plant to wilt and dry up at any time in its growth. The root remains normal

but the veins in the stems become yellow and then black. If the stems are cut cross-wise, drops of yellow, viscid material ooze from the veins. The disease is most severe on sweet corn. It may be carried in the seed, in diseased stalks and in manure.

The disease can be controlled by selecting the seed from healthy plants, by burning the old stalks and by avoiding the use of manure from stock fed on diseased corn on land to be put in corn. The greatest care should be taken in selecting seed corn. Slightly infected plants will produce and carry the disease.

Bacterial Disease of Corn

This is a very common disease of field corn which appears to be increasing in severity in New Jersey. The disease is at first detected by a dwarfing and sometimes yellowing of the young plants in more or less definite areas which cannot be connected with variations in soil or drainage. At tasseling time the disease may be detected on individual plants throughout the field. The lower leaves die in advance of the lower leaves of healthy plants, the dying usually beginning at the tips and margins. After mid-summer the leaves and sheaths of slightly infected plants show irregular reddish or brownish spots of various sizes; corroded spots which are sometimes covered with masses of semi-transparent, rather firm, gummy material appear on the lower part of the stalk; the ears are occasionally affected, the outer husks dying and in extreme cases the ears rotting more or less; sometimes one-half of the roots are dead; when the stalks are split lengthwise pronounced discolorations will be found at the lower joints. This disease is very closely associated with the root rot of corn.

TREATMENT. There is at this time no known treatment for this disease other than by crop rotation and by the use of healthy corn for seed.

Root Rot of Corn

We have received an increasing number of complaints concerning an improper development of corn. The trouble is evidently due to a fungus (*Fusarium* sp.) which causes a rotting of the roots. Many plants are dwarfed and produce ears of little or no value. Some plants fail to tassel while others open slowly. Some plants are well developed and produce good ears but tend to fall before light winds, owing to the damaged root systems which cannot support them. This disease is very destructive in New Jersey and is the cause of very heavy losses in some localities. The disease appears to be very closely associated with bacterial disease of corn and also appears to be of much greater importance. The organism is probably the same as the organism causing the wheat scab (page 11).

The only known treatment consists in the use of clean seed and crop rotation. Do not use wheat or rye immediately before or after corn.

Corn Ear Rots

Partly rotten or mouldy ears are occasionally sent to us, but these troubles do not appear to have been of any importance up to this time. The rotting of many of these ears is evidently due to the same organism as that causing the root rot.

Physoderma Disease of Corn

This is a fungous disease which has been introduced into this country from Asia. It is widely distributed and has been found in New Jersey. Up to this time we have no reason to consider it of any importance.

The diseased leaves are rusty in appearance and on close examination show many small reddish-brown spots which are usually somewhat larger and darker on the mid-rib than on the outer parts of the leaf. They are somewhat large on the sheath and on the other parts of the leaf. When the leaves become dry and the spots break, a dark brown dust similar to spores escapes. The disease also attacks the stalk and is especially prominent at the joints. In severe cases the stalks break before maturity. It appears that the fungus is carried in the manure.

TREATMENT. Practice crop rotation and avoid the use of manure from animals fed on diseased corn fodder on corn land.

Grain Rusts

The grain rusts are fungous diseases which are very common, especially on our wheat and oats. They cause reddish brown and black patches on the stems and leaves and sometimes on the heads, and no doubt reduce the yield.

There are no satisfactory methods of controlling these diseases, except the growing of resistant varieties. They receive practically no attention from our New Jersey farmers.

Black Stem Rust of Wheat

(*Puccinia Graminis* Pers)

This is a very severe disease of the wheat which probably reduces the national wheat crop from thirty to fifty million bushels per year. The disease also attacks oats, barley, rye and a number of our grasses. It is not severe in New Jersey. It occurs on the stems and leaf sheaths and to some extent on the leaves, causing more or less circular or elongated spots which finally become black. The first stage which may occur in fall or spring is sometimes spoken of as the "red rust" and the second stage as the "black rust". When severe the vigor of the plant is reduced and the grain shrivelled.

This fungus also attacks the common barberry (*Berberis vulgaris*) causing small, well defined more or less circular, yellowish or orange colored spots on the under surface of the leaves. It is not a very serious disease on the barberry, but the presence of the barberry leads to an increased amount on the wheat.

TREATMENT. The disease can be reduced but not eradicated by the destruction of the barberry. However, it should be remembered that the disease does not attack the Japanese barberry (*B. thunbergii*). Destroy the common barberry and encourage the planting of the Japanese barberry as a desirable ornamental shrub. These two plants can be distinguished as follows:

Common barberry (<i>Berberis vulgaris</i>) (Fig. 2a.)	Japanese barberry (<i>Berberis thunbergii</i>) (Fig. 2b.)
Plants 4 to 8 ft. in height and erect.	Plants 2 to 4 ft. in height and spreading.
Stems gray or grayish green.	Stems reddish brown.
Spines varying from 10 at base of stem to 1 at top, but mostly 3 in a group.	Spines mostly single sometimes 3 in group.
Leaves relatively large, broad green or purple and with spiny teeth on the margin.	Leaves relatively smaller, spoon-shaped, green and with smooth margin.
Flowers and berries in long cluster.	Flowers and berries single or in cluster of two or three.

Orange Rust of Wheat (*Puccinia triticina* Eriks.)

This is a very widely distributed rust disease of the wheat, but it is not very injurious. It appears as more or less circular or elongated orange colored spots on the leaves, especially on the lower surface.

Corn Rust (*Puccinia sorghi* Schu.)

This is a very widely distributed disease which causes elongated rusty spots on the leaves. It is of comparatively little importance in New Jersey. There is no known satisfactory treatment.

Timothy Rust (*Puccinia phlei-pratensis* E. & H.)

We have not found this disease in New Jersey, but it occurs in neighboring states. It causes more or less circular or elongated dark brown or black spots on both sides of leaf, stem and spike. The spots on the stem are more elongated than those on the leaves and tend to unite, forming irregular areas. These spots rupture and liberate the spores. When severe the disease tends to dwarf the plants.

Powdery Mildew of Wheat (*Erysiphe graminis* D. C.)

The fungus appears on the leaves as a whitish, flour-like covering. It is quite common and sometimes injurious in wet shaded spots. Rye, barley and oats are also subject to the attacks of the mildew. Conditions favorable for the development of the fungus should be avoided.



Fig 2. The Common and the Japanese Barberry

a. Stem, leaf and fruit of common Barberry

b. Stem, leaf and fruit of Japanese Barberry

Wheat Scab

(*Gibberella saubinetii* (Mont.) Sacc.)

This disease is due to a fungus which attacks the immature heads, producing yellowish or pinkish incrustations at the base and over the spikelets. The diseased parts turn yellow and ripen prematurely. The upper middle or lower third, sometimes both the upper and lower thirds, or sometimes the entire head may be diseased. The diseased grains are more or less shrunken and often covered with a thick, felty mass of fungus. The scab sometimes causes considerable losses which are very evident at maturity. It also attacks the seedlings, killing 5 per cent or more. It can also be found on the roots of the growing plants throughout the entire growing season and no doubt reduces the vitality and yield. The organism is the same as that causing the root rot of the corn (page 7). This disease also attacks the rye. The only known treatments consist in the use of seed from healthy plants and the rotation of crops. Do not use corn and either wheat or rye in the same rotation.

Anthracnose of Wheat, Rye and Oats

(*Colletotrichum graminicolum* Cesati)

This is a fungus disease which causes a blighting of the growing grain near maturity. It resembles the scab, but there is none of the pinkish incrustation. The grains are shrivelled and light. The minute black fruiting bodies may appear on any part of the plant above ground. There is no known satisfactory treatment.

Black Mold of Wheat

(*Cladosporium* sp.) (Fig. 3)

This disease occurs on and causes a pronounced blackening of the heads and considerable loss. It is especially severe when we have moist weather as the grain approaches maturity. Since the growth of the fungus is largely dependent on the weather conditions, there is no known treatment.

Sterile Spikelets In Wheat

Sterile spikelets may be due to fungus organisms or to heavy seeding, early seeding, improper fertilizers or other factors. They are less common with nitrogen alone than with other fertilizers alone and less common on the smooth than on the bearded varieties.

Eelworm or Nematode Disease of Wheat

(*Tylenchus tritici* (Stembuch) Bastian)

This is a very destructive European disease which has been introduced into this country. It is caused by a very small microscopic worm. It is known to be present in Virginia and one locality in California and possibly other wheat growing districts. The diseased spikes remain green after the healthy spikes have ripened. The diseased grains develop into short, hard, black bodies which are sometimes mistaken for bunt, cockle seed, or bin-burnt wheat.

TREATMENT. The only treatment for this disease is prevention. Be careful as to the source of your seed; plant nothing but healthy seed. When the soil is infected, crop rotation must be practiced, but there is always danger of carrying the organism from field to field on the farm implements and on the feet of the live stock and farm laborers. *Keep this disease out of New Jersey.*

Bacterial Disease of Oats

The yellow and pinkish spotting and streaking of oats especially, and also wheat and grasses, is apparently due to bacterial organ-



Fig. 3. Black Mold of Wheat

isms. The organisms causing these diseases are very materially influenced by the weather conditions. These diseases are without doubt the cause of material losses.

Ergot on Rye—"Spurred Rye"

(*Claviceps purpurea* (Fr.) Tul.) (Fig 4)

Although this disease is most common on the rye, it also attacks the wheat and several grasses. The fungus appears as hard, black or purplish spur-shaped bodies projecting from the spike. It is not very injurious to the plant and the loss is slight, but these hard spur-like bodies are poisonous to stock, causing sickness and sometimes death. Evidence of ergot poisoning usually appears in the spring after continuous feeding on infected grain or forage. The animals are emaciated and rough-haired, their circulation is slow, gangrenous sores form on the teats and mouth, parts of tail, ear and hoofs may slough off, and abortions are of common occurrence.

TREATMENT. The fungus is carried from year to year either by the hard bodies in the seed or those that fall to the soil before

harvesting. It is short lived and can be removed by crop rotation and seed treatment. In seed treatment, clean the grain as thoroughly as possible by running through the farming mill; to the rye then add a 20 per cent salt brine (40 pounds common salt and 25 gallons of water), stir thoroughly and remove the ergot and light grains which rise to the top; rinse in clean water and dry thoroughly.

Sclerotium Grass Disease

(*Sclerotium rhizodes* Amersu.)

This is a fungous disease which attacks several species of grasses but is of little importance in New Jersey. When affected by the



Fig. 4. Ergot of Rye

disease the plants are dwarfed; the upper leaves cannot unfold properly because they are bound together by a white fungus growth; the force exerted by the growth of the inner leaves results in a peculiar crooking of the tip of the plant; the infected parts become white, dry and rigid. The fungus infects all parts of the plant.

Sudan Grass

This is a new crop in New Jersey, and we have not made a study of its diseases. However, the Kansas Agricultural Experiment Station reports the occurrence of a smut, a bacterial leaf spot, and a wilt due to a root inhabiting fungus.

Anthracnose of Alfalfa (*Colletotrichum trifolii* Bain)

This disease is characterized by the blackening of the crowns. Black spots also occur on the stems but these are only indicative of the trouble lower down. On affected plants either part or all of the stalks are attacked. The first symptoms are a general wilting of the stalks, followed later by death due to the girdling at the base brought about by the action of the fungus on the stem tissues. Clean seed selection appears to be helpful.

Other Diseases of Alfalfa

Wilt (*Sclerotinia libertiana* Fckl.), root rot (*Rhizoctonia medicaginis* DC), and "damping off" of alfalfa seedlings (*Pythium debaryanum* Hesse) are diseases which may develop on alfalfa plants with consequent injury and loss.

The root rots are of the greatest importance, but at the present time our knowledge concerning their causes, exact symptoms and methods of control is very meager. It is a subject which should be very carefully studied.

Diseases of Clovers **Leaf Spot**

(*Pseudopeziza trifolii* (Pers.) Fckl.)

This is a disease of little importance, though occasionally infections may be quite severe. The symptoms are the same as in alfalfa leaf spot, except that spots may appear on both surfaces of the leaf. Methods of control are the same as for alfalfa.

Stem Rot

(*Sclerotinia trifoliorum* Eriks.)

In this disease a decay is produced at the base of the plant, as a result of which the plant wilts and dies. Crimson clover seems to be particularly susceptible to this disease and many cases were reported in New Jersey in 1913 and 1914. Rotation of crops is important in the control of this disease.

Anthracnose

(*Colletotrichum trifolii* Bain)

Attacks red clover, while alsike is practically immune. It produces black spots on stems, rarely on leaves. Cultural methods play no part in control. Clean seed selection seems important.

Rust

(*Uromyces trifolii* (Hedw.) Lev.)

This disease attacks all clovers and is some times more serious than the leaf spot, depending a great deal upon climatic conditions. It is characterized by small yellowish brown pustules on the lower surface of the leaves and on the stem. These pustules bear the spores which spread the disease. No control measures are known.

Sooty Spot

(*Phyllachora trifolii* (Pers.) Fel.)

This disease causes black, more or less circular spots on leaves. It is most common on red and on white clover. It may kill the leaves where severe infection occurs. No control measure is known.

Alfalfa Leaf Spot

(*Pseudopeziza medicaginis* (Lib.) Sacc.)

This disease is a very common one on alfalfa and is usually more abundant on the later cuttings. It may, however, cause considerable loss on the first cutting according to recent observations in this state. The early symptoms are the appearance of small sooty, brown or black spots on the upper surface of the leaves, those toward the base being attacked first. These spots vary in diameter up to about one-sixteenth of an inch.

When the spots are very numerous, the leaves are killed and drop from the plant. The loss may amount to 50 or 75 per cent of the foliage in some cases. The vigor of the plant is greatly lessened, and death may result from repeated attacks of this disease.

CONTROL. No method is known for successfully controlling the disease once it has become established. If infection is quite severe, the crop should be cut before the leaves begin to die and drop from the plant. Any practicable means of cleaning up and destroying dead stalks, fallen leaves, etc., should serve to lessen the amount of infection. The disease appears to be less severe on land which has been well limed.

Yellow Leaf Blotch of Alfalfa

(*Pyrenopeziza medicaginis* Fehl)

This is a fungous disease which attacks both leaves and stems but is much more severe on the former. On the leaves it causes yellow blotches, running more or less parallel to the veins. The fruiting bodies are very small and appear on the upper surface of the leaves. On the stems the fungus causes yellowish blotches which turn brown. It is difficult to estimate the losses due to this disease but they are quite heavy. The control is the same as for leaf spot.

Other Leaf Spots of Alfalfa

There are some other diseases of alfalfa which may be designated as "leaf spot" diseases, but which are quite distinct from the ones just described. These are of comparatively infrequent occurrence and may pass unnoticed by any except the more careful observer. Of this class may be mentioned the *Cercospora*, *Ascochyta*, and *Stagonospora* leaf spots, named according to the particular organism producing the disease.

There is also a white leaf spot which has been quite prevalent in some fields. The leaves are irregularly spotted with whitish areas of varying size which at first suggest the work of insects.

This is not the case, however, and all studies so far have failed to reveal any causal organism. Plants thus affected stand out prominently in the field and later the leaves turn yellowish and become dry.

Dodder on Clover and Alfalfa

Dodder is a flowering plant which lives parasitically on clover alfalfa and other plants. The plants are long, yellow and thread-like. They twine about the host plant and send root-like processes into the stems. The flowers are small and white. When abundant they are very destructive.

TREATMENT. Mow the infected area, if possible, before the seeds mature, and burn.

Winter Injury of Clover and Alfalfa

The alternate freezing and thawing tends to break the roots, lower the vitality and make the plants more susceptible to fungous diseases especially those that cause root rots.

Note: The introduction of a new crop and the devoting of large areas to its production, introduces many new problems in plant diseases. These new diseases may ravage the crop before they are thoroughly understood and before control measures can be developed. It is, therefore important that any indications of abnormal conditions in alfalfa and other crops should be reported to the Plant Pathologist as soon as observed.

INDEX

Disease of	Page	Disease	Page
Alfalfa	14	Anthracnose	11, 14
Barley	6	Bacterial disease	7, 12
Clover	14	Black mold	11
Corn	6	Damping off	14
Grass	13	Dodder	16
Oats	3	Eelworm disease	11
Rye	5	Ergot	12
Timothy	5	Leaf spot	14
Wheat	5	Physoderma disease.....	8
		Rots: root, stem, corn ear....	7, 8, 14
		Rusts: orange, black stem....	8, 9, 14
		Scab	11
		Sclerotium disease	13
		Smuts: loose, covered, stem	
		stinking	3, 4, 5, 6
		Sterile spikelets	11
		Yellow leaf blotch	15
		Wilt	6, 14